Claims

1. A method of analysing scale at a location in a hydrocarbon well flow system, comprising the steps of:

(a) using an *in situ* gamma-ray detector to obtain a gamma-ray spectrum from said scale, and

(b) spectroscopically analysing said spectrum to determine the abundances of radioactive isotopes in said scale.

2. A method according to claim 1, further comprising the step of:

(c) repeating steps (a) to (b) to monitor the development of said scale.

3. A method according to claim 2, further comprising the step of:

(d) using said abundances to determine the specific activity of said scale.

4. A method according to claim 3, further comprising the step of:

(e) using said abundances to determine the permeability of said scale.

5. A method according to claim 4, further comprising the steps of:

(f) using said abundances to determine the amount of radium originally deposited in said scale, and

(g) deriving the quantity of said scale from said amount of radium and from the relative concentrations of radium and the other scale components in the fluid from which said scale deposits.

6. A method according to claim 5, in which the primary scale component is barium.

7. A method according to claim 1, wherein said gamma-ray detector is stationary.

8. A method according to claim 1, in which said gamma-ray detector is permanently or semi-permanently installed in said hydrocarbon well flow system.

9. A method according to claim 1, in which said gamma-ray detector is installed downhole.

10. A method according to claim 9, in which said scale is located in a well formation.

11. A method according to claim 9, in which said scale is located in the well production tubing.

12. A method according to claim 1, in which said gamma-ray detector is installed above ground.

13. A method according to claim 1, wherein in step (a) said spectrum is obtained over a time interval of at least ten minutes.

14. An apparatus for determining at least one characteristic of scale at a location in a hydrocarbon well flow system, the apparatus comprising:

a radiation detector; and

a signal processor, said radiation detector being adapted to (i) be installed *in situ* in said system, (ii) obtain a gamma-ray spectrum from said scale, and (iii) send a measurement signal encoding said spectrum to said signal processor, and said signal processor

being adapted to receive said measurement signal and configured to analyse spectroscopically said spectrum to determine the abundances of radioactive isotopes in said scale.

15. An apparatus according to claim 14, wherein said signal processor is further adapted to determine from said abundances the specific activity of said scale.

16. An apparatus according to claim 14, wherein said signal processor is further adapted to determine from said abundances the permeability of said scale.

17. An apparatus according to claim 14, wherein said signal processor is further adapted to determine from said abundances the amount of radium originally deposited in said scale and thence derive the quantity of said scale from said amount of radium and from the relative concentrations of radium and the other scale components in the fluid from which said scale deposits.

18. An apparatus according to claim 14, wherein said radiation detector is adapted to be held stationary in said hydrocarbon well flow system.

19. An apparatus according to claim 14, wherein said radiation detector is adapted to be permanently or semi-permanently installed in said hydrocarbon well flow system.

20. An apparatus according to claim 14, wherein said radiation detector is adapted to be mounted to a hydrocarbon well production tubing.

21. An apparatus according to claim 14, wherein said radiation detector is adapted to be cemented to a hydrocarbon well borehole casing.

22. An apparatus according to claim 14, which is installed in said hydrocarbon well flow system.